

REMARKS

Applicants thank Examiner Nguyen for conducting the kind and courteous discussions with Applicants' representative, Daniel R. Evans, on October 6, 2005 and February 8, 2006. The content of the discussion is reflected in the amendments to the claims and the following remarks.

The rejection of Claims 1-4, 6-8, and 35-38 under 35 U.S.C. § 102(b), or in the alternative under 35 U.S.C. § 103(a), over the disclosure of U.S. Patent 4,080,286 ("Yanik") is respectfully traversed.

Yanik discloses a hydrodesulfurization process catalyst that is prepared by successively impregnating a inorganic oxide carrier with a transition metal followed by heating the metal-impregnated carrier (see Examples 1-2, col. 4, lines 8 – col. 5, line 20). A Ti-Ni-Mo-alumina catalyst is prepared as follows (Yanik; Example 1; col. 4, lines 7-39):

- (1) impregnating a calcined alumina carrier with Mo;
- (2) heating the Mo-alumina carrier at 121°C;
- (3) impregnating the Mo-alumina carrier with Ni;
- (4) heating the Ni-Mo-alumina carrier at 121°C and then at 538°C;
- (5) impregnating the Ni-Mo-alumina carrier with Ti; and then
- (6) heating the Ti-Ni-Mo-alumina carrier at 121°C and then at 538°C.

The Examiner's attention is directed to steps (4) and (6), which include heating at a temperature of 538°C.

Applicants note that the hydrogenation catalyst according to Claim 1 is unlike the catalyst disclosed in Yanik for at least the following reasons.

The calcining temperature is not higher than 300°C. In the case example 1 of the present patent application, although the carrier is calcined at 500°C, the catalyst is heated at 120°C for 16 hours.

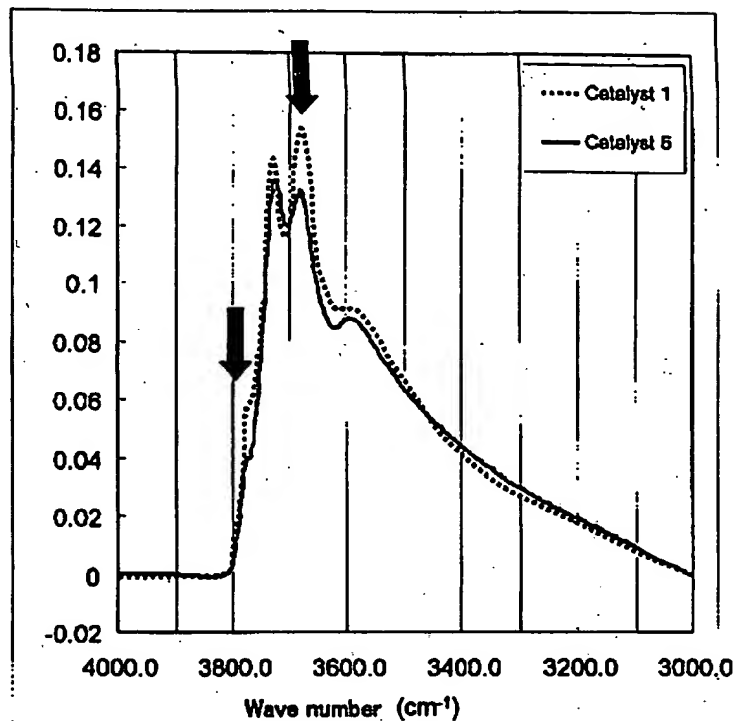
This is in contrast to the catalysts disclosed and suggested in Yanik, which are calcined at 538°C. Applicants note that if the calcining temperature is higher than 300°C, the components held on the carrier will agglomerate and will fail to have high activity. The Examiner's attention is directed to the text on page 21, lines 2-11, of the present Specification, which states that the "temperature for the heat treatment is not higher than 300°C...[if] the temperature for the heat treatment is too high, the components held on the carrier will agglomerate and will fail to have high activity."

As previously noted, this is a critical aspect of the presently claimed invention that gives rise to differences between catalysts calcined at a temperature not higher than 300°C and catalysts calcined at a temperature higher than 300°C. For instance, the Examiner is asked to compare the differences between Catalysts 1 and 5. The preparation of Catalyst 1 is disclosed in Example 1 of the Specification on pages 46-47, which is a catalyst that falls within the scope of Claim 1. The preparation of Catalyst 5 is disclosed in Comparative Example 2 of the Specification on page 50, which is a catalyst that falls outside the scope of Claim 1 and resembles a catalyst that would be obtained based on Yanik's disclosure. The difference between these two catalysts is that catalyst 5 was heated (after impregnating) to a temperature in excess of 300°C. (See page 47, second full paragraph, for experimental conditions for the preparation of catalyst 1; and page 50, second full paragraph, for catalyst 5.) This difference is manifested in the concentration of Type III hydroxyl groups (see Lewis et al. Journal of Catalysis, 136, pp. 478-486 (1992)¹). That is, catalyst 1 has a greater

¹ See Reference AW cited in Information Disclosure Statement filed June 9, 2004.

concentration of Type III hydroxyls than does Catalyst 5. This can be gleaned by inspecting the IR comparison spectra shown in Figure A.

Figure A. Comparison IR Spectra of Catalyst 1 and 5



IR Chart Catalyst 1 and Catalyst 5

Thus, there is a chemical difference between the catalyst 1 and catalyst 5 because there is a difference in the number of different types of metal bound hydroxyls. This difference manifests itself in the desulfurization activity, which is tabulated on page 72 in Table 3, which is represented in Table A below. In short, catalyst 1 is 36 % more active than catalyst 5. This difference is at least partially attributable to the chemical differences between the two catalysts, as detected by IR spectroscopy.

Table A. Comparison Data for Catalysts 1 and 5

	Catalyst 1 – Example 1	Catalyst 5 – Comp. Example 2
Heating after second impregnation	not more than 300°C	more than 300°C
Specific Heating Conditions	120°C (16 hrs)	120°C (3 hrs) and 500°C (3hrs)
	Composition, wt%	Composition, wt%
NiO	5.0	5.1
MoO ₃	28.2	28.3
P ₂ O ₅	2.5	2.4
TiO ₂	3.2	3.2
Al ₂ O ₃	61.1	61.0
	Physical Properties	Physical Properties
Mean Pore Diameter, Å	85	85
Specific Surface Area, m ² /g	250	248
Total Pore Volume, cc/g	0.53	0.52
	Catalyst Activity	Catalyst Activity
Rel. Desulfurization Activity	150	110

As noted above, Catalyst 1 is 36 % more active than Catalyst 5. This difference in activity is attributable to the difference in heating after the second impregnating step. If one were to employ the catalyst procedure disclosed in Yanik, based on the data presented above, one would expect to obtain a catalyst having lower activity, when compared to a catalyst that falls within the scope of Claim 1. It is believed that this aspect is unexpected, and serves as a basis of patentable distinction over the disclosure of Yanik.

Applicants note that the product-by-process limitation of Claim 1 provides patentable distinction from catalysts disclosed in Yanik. A manifestation of the product-by-process limitation is that the catalyst of the present invention has a high dispersion of active metals (Group 6 and Group 8-10), which is a result of the low calcining temperature and also because of highly dispersed titanium oxide, using a salt of a titanium-peroxohydrocarboxylic acid.

This high dispersion of titanium oxide provides a basis for Claim 60, in which the ratio of Fm-to-F is at least 0.5 (see page 37, lines 1ff), as evidenced by electron probe microanalysis (EPMA) data.

This difference is further recognized when one inspects the desulfurization and denitrogenation data of Catalysts 24, 25, and 26 (see page 75). Catalyst 25 (Example 16) shows better performance for desulfurization and denitrogenation than catalysts 24 and 26. Please refer to Table 10, 11, and 12.

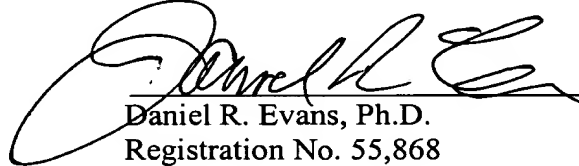
Applicants also note that the catalyst recited in Claim 64 is distinguishable from the catalyst disclosed and suggested in Yanik. That is, a catalyst that is substantially free of chloride is unlike the catalyst disclosed in Yanik. Applicants note that Yanik discloses a catalyst that is obtained by impregnating a solid support with TiCl_4 under substantially anhydrous conditions (see Yanik at col. 4, lines 32-36). It is reasonable to infer that under these conditions, the catalyst of Yanik would contain a substantial amount of chloride. Applicants note that a catalyst containing chloride would cause a reduction in the desulfurization activity of the catalyst. The reason for this is that if chloride is present it will serve as a bridging-ligand between two metal sites. If it acts as a bridging-ligand then reduced activity may be realized for that metal-metal site because it is believed that the activity is at least in part attributable to the bridging hydroxyl group.

Application No. 09/868,628
Reply to Office Action of August 9, 2005

The shortened statutory period for response to the August 9, 2005 Office Action ended on November 9, 2005. This present paper was filed on February 9, 2006. Applicants file concurrently herewith a request for extension of time under 37 CFR § 1.136, with the appropriate fee under 37 CFR § 1.17. Should there exist a variance between that which is paid and owed, the Office is authorized to charge deposit account number 15-0030, in order to maintain pendency of the above-identified application.

Respectfully submitted,

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